

ARGONNE NATIONAL LABORATORY

INTRA-LABORATORY MEMO



Advanced Photon Source

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To: J.M. Gibson Associate Laboratory Director – APS
From: R.D. Hislop APS ESH/QA Representative
Subject: Management Evaluation Of Work Practices Associated With Beamline Critical Components

Summary

During the summer of 2002, following the scheduled repair of the 2-BM beamline P6 shutter/stop, the individuals involved in the maintenance activities realized that they had improperly reassembled the shutter. Fortunately they made this observation well before the beamline was returned to operation. The condition in which the shutter had been left before the error was realized would have resulted in the improper operation of the shutter, but would not have resulted in an unsafe condition. A detailed analysis by the APS Radiation Scientist determined that the calculated “Dose Rate” for the worst-case scenario resulting from the improper operation of the shutter would increase the radiation in the experiment enclosure by less than 0.1 $\mu\text{rad/hr}$. When the AOD and ASD Division Directors were informed of the situation they directed that an assessment be conducted to determine the shortcomings in their work processes resulted in the configuration control deficiency. The resulting assessment titled “2-BM Shutter Configuration Problems” revealed a number of opportunities for improvement in beamline work coordination and documentation. After reviewing the report the APS Associate Laboratory Director appointed an Ad-Hoc committee to evaluate work planning and execution during the maintenance beamlines in general. The recommendations of both evaluations are summarized in this report, however their unanimous conclusion was that APS should assume ownership of all beamline critical components.

Report

The actuator for the 2-BM beamline P6 shutter/stop was being repaired in July 2002 when it was determined that the bremsstrahlung Stop in P6 was sticking. In response to this observation the Stop actuator was replaced. After the work was done a beamline user observed that the mechanical actuators were operating, but the Personal Safety System (PSS) control panel was not giving the proper mode indicator signals. The User brought this observation to the attention of the responsible ASD-ES engineer who, on the assumption that the ASD-ES technician had connected the PSS switches improperly, reversed the PSS leads. The P6 PSS controls then responded as the engineer expected they should. The following morning the ASD technician told the ASD-ES engineer that he had not switched the leads. When they inspected the shutter they determined that it had not been properly assembled and rectified the situation.

They then reported the situation to both the ASD and AOD division directors. They in turn directed that an incident analysis be conducted to identify the circumstances leading to the situation and to determine if there were any safety issues that needed to be addressed. The individuals assigned this task produced the "2-BM Shutter Configuration Problems" evaluation report where they identified several shortcomings in the maintenance process and configuration of the 2-BM P6 shutter /stop. They discovered that a pin that serves as the stop for the bremsstrahlung Stop and the Kirk key system for the shutter was missing. The evaluation also identified the lack of readily accessible documentation for and operational knowledge of the P6 shutters. They concluded that responsibility for the maintenance of critical systems on the beamlines is not clearly defined.

After reading this report and discussing the report conclusions with the APS Safety Oversight Committee the Associate Laboratory Director for the APS appointed Ad-Hoc committee to evaluate work processes associated with the maintenance of beamlines. The committee affirmed the observations made in the "2-BM Shutter Configuration Problems" report and made several observations of their own related to beamline and critical component maintenance.

The committee was satisfied that in spite of the fact that no single technical group has responsibility for the design of new beamline critical components that critical components are being effectively designed to prevent unintentional x-ray exposure in beamline hutches. In fact, APS has two committees, the APS Beamline Review Committee and the Beamline Commissioning Readiness Review Team charged with reviewing and approving drawings of critical components prior to their assembly and installation.

During the course of their inquiries the committee identified the opportunity for an improvement to the design of the shutters that would reduce the probability of the improper alignment of shutters when replaced following maintenance. They were concerned that the Rad surveys conducted after shutter repairs/maintenance would not be valid if beamline components/optics are left unintentionally blocking the beam thereby not providing the worst-case conditions. The committee suggested that future designs address the issue of in-situ shutter alignment.

The committee confirmed that the Floor Coordinators had inspected the Kirk locks on all the shutters to establish that all the locking pins are in place in all the shutters in response to the observation of the initial safety assessment. An evaluation of work practices revealed that an independent check of the proper configuration of the shutters has not been a regular part of APS procedures prior to the resumption of operations. To that end clear procedures and complete documentation that identifies proper configuration control should be readily available for the technicians performing work on critical safety components.

Documentation - In regard to documentation, there is currently no single individual or group responsible for collecting and controlling as-built beamline documentation or for the critical components. The documentation that is available resides with the engineers and floor coordinators responsible for individual systems and to some extent in the DCC. Personnel coordinating and performing maintenance and repair work do not always know who these

individuals are and therefore where to go to retrieve this information. The committee is concerned that the absence of readily available documentation makes it difficult for maintenance personnel to assure that proper critical configuration control is maintained. The current status of documentation is as follows:

Beamline Design Drawings - The Experimental Floor Operations Group has what appears to be the best collection as -installed beamline documentation.

PSS/EPS System Documentation - The paper and electronic files of the PSS/EPS system designs are kept by the PSS/EPS group.

Beamline Review Documentation - Records of beamline reviews are stored in an AOD filing cabinet. These files contain the best collection of beamline ray-tracing analysis. These files also contain some beamline component design, but the as -installed beamline drawings are not complete.

Work Assignment - Technical groups responsible for maintenance and repair of components are not always made aware that the component to be worked on is a critical one. Nor is there a mechanism to systematically identify who worked on the system or that the work was completed and returned to a pre-existing configuration.

The committee concluded that only a discreet number of individuals should have authority to work on critical safety components. For this process to work there would need to be in place directives identifying the engineer/technician-on-call for emergency response.

Currently any work done on beamline components which are under configuration control (critical components & radiation shielding) requires a "Configuration Control Work Permit" (ccwp) be initiated. In addition an APS Work Request form is initiated in some instances. The current Work Request form does not identify that the component to be worked on is a critical component. To assure that all the individuals working on critical components are aware of the status of the component and to be able to clearly establish accountability the work the Work Request Form should be modified and a Traveler system should be implemented for work on critical components. The "Traveler" should include the signature of individuals who worked on the equipment in order to maintain a clear chain of custody. In addition a guide should be developed to clearly delineate the work sequence to be followed when working on critical components.

Training - The committee concluded that all the individuals assigned to perform work on critical components do not all have the requisite training necessary to maintain the components. Further, the oversight of work practices and verification of the safe reassembly of these components is inadequate.

Recommendations:

APS management will implement the following recommendations to improve control of critical components. The Ad-Hoc committee report provides examples of the types of documents they suggest be developed in the following recommendations:

1. APS management should declare ownership of critical components once they become part of a beamline so it is clear who is responsible for its subsequent maintenance and repair.
2. Future shutter designs should incorporate the means to assure that they have been correctly positioned after in situ repairs are completed.
3. Procedures, drawings, and documents for critical beamline components should be archived in the Document Control Center (DCC). To expedite the collection of this information one individual should be assigned this task.
4. The APS work request form should be modified to identify that a critical component is involved in the work to be performed to assure that any special requirements such as identifying procedures, schematics, drawings, etc. are brought to the attention of the individuals assigned to perform the work.
5. Implement a "Traveler" to track work on critical components. The traveler should define the work to be performed by each group and require that each worker and supervisor involved in the work sign that the work was completed according to a procedure.
6. Develop a procedure that clearly defines the control and workflow during maintenance or repair of critical components. The procedure should specify approval to perform work, identify oversight requirements, training requirements, and the validation process required to resume operations.
7. Develop a training program for technical groups responsible for installation, maintenance, and repair of critical components. The training should include operation of the device; location of procedures, drawings, and documents; and instruction on complying with the work request and traveler.

Suggestion

The committee suggested that APS develop an equipment monitoring system for preventive maintenance. The EPICS system can be programmed to process variables for critical components such as monitoring shutter closing times. Worsening time-to-closure is a warning of impending shutter failure. This monitoring system could subsequently be extended to front ends.

Conclusion

There were no imminent danger situations or unidentified safety issues brought to light through either evaluation of the 2-BM Sutter incident. However, there were a number of opportunities for improvement brought to APS management attention. A Critical Component

Systems Manager has been assigned the responsibility of addressing the recommendations and was charged with reporting his progress to the APS Operations Group on a quarterly basis until the implementation is complete in 12 months, September 2, 2004.